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LOCO WEED.

(Astragalus mollissimus; Nat. Ord. Leguminosæ.)

BY L. E. SAYRE, PH. G.,

Kansas State University, Department of Pharmacy.

The plant commonly known as Loco or Crazy Weed has for many years excited much curiosity, as being one which produces upon animals who feed upon it very peculiar and sometimes alarming effects. Indeed, it is said by ranchmen to cause many of the heaviest losses among their cattle and horses.

With a view of gathering some statistics concerning the effects of the weed upon animal life, and the extent of loss therefrom, I visited, in January last, certain parts of New Mexico and Colorado, and since the meeting of the Kansas Academy of Science* have made a special trip for the same purpose, visiting more especially the southwestern portion of Kansas, from Harper to Meade counties. The latter trip was occasioned by Mr. Robert E. Steele, on the "Crooked L" ranch at Meade Center, who wrote he had a locoed cow which he would place at my disposal for examination if I would take the journey to his ranch.

The plant begins to appear at about Medicine Lodge, and to extend southwesterly into the Indian Territory and northwesterly through the State of Kansas. At Dodge City it was found growing abundantly in spots, although no locoed animals could be found or heard of thereabouts. Ranchmen say they have not been so much troubled with it in recent years, but scores had lost heavily from it in years past. It was ascertained from what appears to be reliable authority, that about 500 animals have been lost in Meade county during the past five years from the effects of this weed, though occasionally a person was met with who firmly asserted that the plant in question did *not* cause the so-called loco disease. A butcher in Grenada, Colorado, who had been interested in raising cattle and horses, and seemed to be quite intelligent in his subject, most positively stated that "he did not believe one word of all that was said about the Crazy weed. He had read and heard a good deal, but he had yet to see an animal becoming affected by loco. He had pastured right in it, and never lost one animal." A number of others gave like testimony. It would be impossible in the brief space of this article to give the various and sometimes conflicting statements concerning this weed. Evidently there has been a lack of accurate and skillful observation in the matter. The great majority report that the plant is truly named, as it makes the animals not only crazy, but is sure to kill them eventually. Dr. P. Harding, of Dodge City, a veterinary surgeon, stated that at one time he was dealing quite extensively in horses, and had lost a number from what he believed to be the effect of loco. In order to satisfy himself, he performed two experiments upon horses, with the weed; the first experiment being in the field, and the next in the barn. In the field he pastured two horses, both horses having a taste for loco. One of the horses found abundance of the plant in his pasture; the other horse found *none*, because it had been carefully removed from his portion of the field. The first horse died in the pasture; the second recovered from the previous feeding. In the barn he also placed two horses similarly affected, and fed one with dried loco, the other with clean hay. The first died and the other recovered.

The following summary of the effect of loco is based upon personal inquiry among ranchmen. The animal unaccustomed to the weed will not touch it as long as good feed is to be had, but after once partaking of it — driven to it in early spring

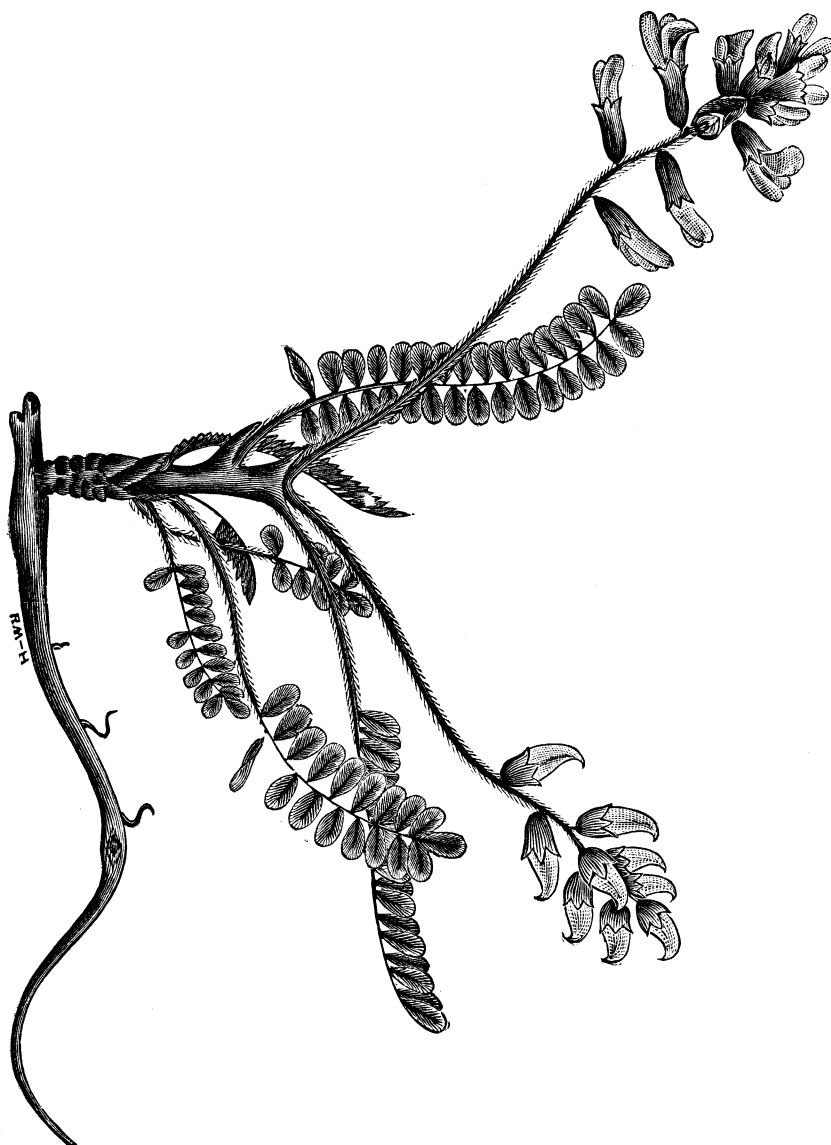
*The present paper is a revision of the one read at the last meeting of the Kansas Academy of Science, including the recent researches.

by the want of green vegetation—soon comes to prefer it to any other food, and finally refuses any other, leaves the herd and wildly searches for loco. The first effect upon the animal is hallucination. When led or ridden up to some trifling obstruction, such as a bar or a rope lying in the road, he stops short, and if urged on leaps over it as if it were a rail fence four feet high. Seemingly the optic nerve is affected; all sense of distance and dimension seems to be lost; a barn near at hand is to him afar off, and one a mile away near by. He will go headlong against a barn or a rock, or over a precipice, as if he were totally blind. The animal will, perhaps, let one get close to him, then suddenly and wildly run away at full speed and as suddenly stop, turn around, and it may be, come right back, stop short, stare, “and act like mad.”

Mr. Wm. Smith, in the employ of Bollinger & Schlupp, ranchmen, seventeen miles south of Kiowa; Mr. D. R. Streeter, upon the “Z & Z” ranch, near Kiowa; and Mr. Steele, above referred to, are all quite familiar with the symptoms, and agree in every prominent particular concerning them. Mr. Steele gives as one of the prominent characteristics of the disease, “a stony stare.” “If a sharp, quick motion is made before the animal’s eyes, such as throwing up of the arms suddenly, it is likely to fall to the ground in apparent fright, as though not able to control its muscles.” Sometimes a horse is seized as with a mania, in which he is quite uncontrollable and dangerous. He rears, even to falling backward, runs, or gives several successive leaps forward, and generally falls. His eyes are rolled upward until the whites can only be seen, which are strongly injected, and since he can see nothing is as apt to leap toward a wall or a man as in any other direction. Anything that excites him appears to induce such fits, which are perhaps more apt to occur in crossing water than elsewhere, and the animal sometimes falls so exhausted as to drown in water not over two feet deep. He loses flesh from the first, and presents the appearance of a skeleton. Nutritive energy seems to be paralyzed. In the last stage he only goes from loco to water and back. His gait is feeble and uncertain; eyes sunken, flat and glassy; his coat rough and lusterless, and in general the animal seems to suffer from starvation and constant excitement of the nervous system. Sometimes also he appears to experience acute pain, causing him to run from place to place, paw and roll until he falls, and then dies in a few moments. A correspondent from Texas states “he cannot tell when a horse is ‘locoed’ until he drives him very hard. After becoming heated he begins to be excited, and then the peculiar effect of loco appears.”

There are two plants known as crazy weed, common in Kansas, Colorado, and New Mexico—the *Astragalus mollissimus*, and *Oxytropis Lamberti*, both belonging to the natural order Leguminosæ. E. A. Popenoe, Manhattan, states he has received from different parts, as specimens of crazy weed, beside the above, the following: *Malvastrum coccineum*, *Sophora sericea*, and *Amarantus albus*; but the writer has found from personal investigation that the farmers of our own and adjacent States mean by this title, “crazy weed,” one or other of the two species above mentioned. Both the *Astragalus* and *Oxytropis* are rather attractive plants, and keep their color all winter.

The *Astragalus* grows on high ground and rather dry soil which is also gravelly and sandy. It blooms about June, and bears a bright-colored flower, rather attractive in its appearance. There are a great many stalks proceeding from the base. These stalks are reclining toward the base and erect and recurved above; subcaulescent, with soft, silky, villous pubescence. The leaflets usually in pairs, except the upper one (composed of from ten to twenty pairs) are somewhat densely clothed with soft, silky hairs. The flower stalk is usually longer than the leaf stalk, naked below, scape-



LOCO WEED.

like, bearing a rather thick spike of flowers, which have the general structure of the Leguminosæ.

CHEMICAL EXAMINATION.

In pulverizing the leaflets, the first portion which passes through the sieve consists almost wholly of the fine hairs which cause the pubescence to the structure. These hairs seem to constitute about one-third of the weight and over one-half of the bulk of the powder. From its light and spongy structure it is difficult to pulverize; the dust arising during the operation is irritating to the mucous membrane

—not from irritating principle residing in the plant, but from the immense quantity of broken, sharp-pointed hairs carried up with it. The light, fluffy character is remarkable, being one-tenth lighter than powdered senna.

PRELIMINARY EXAMINATION.

The air-dried powder was subjected to a temperature of $110^{\circ}\text{C}.$, until it ceased to lose weight. The powder was found by this process to contain 10 per cent. of moisture. It was then incinerated in a platirium crucible, and yielded 12.01 per cent. of ash. The ash yielded to water 25 per cent. of soluble material, and to hydrochloric acid 50.6 per cent., the residue being largely silica. A qualitative analysis of the ash gave the following bases: CaO , K_2O , MgO , Al_2O_3 , Fe_2O_3 ; and the following acid radicals: SO_3 , Cl , P_2O_5 , Co_2 , and SiO_2 .

The powdered drug yielded to water acidulated with hydrochloric acid 30.52 per cent., the solution evidently containing sugar, starch, albuminoids and extractive of unknown composition, but containing no alkaloidal qualities. Petroleum ether, when percolated through the powder until the latter was exhausted, yielded, on evaporation, .8 per cent. of extract. The residue left, after treatment with petroleum ether, was exhausted with sulphuric ether, and the ether distilled off. This extract is entirely soluble in alcohol. By fusing the extract with caustic potash, and applying the usual test for vegetable acids, no reaction is obtained. The ethereal extract thus obtained was 1.12 per cent. From the second residue an absolute alcoholic extract was obtained, which amounted to 1.9 per cent. The petroleum-ether extract consisted mainly of fat, accompanied with chlorophyl. The fusing point of this fat was $47.5^{\circ}\text{C}.$; congealed very readily, showing the presence of a higher carbonaceous fat. It gave a number of interesting color reactions. The ethereal extract contained more chlorophyl, and a soft resin. The alcoholic extract was not examined for proximate principles.

With a view of detecting, by a short process, any alkaloids, two experiments were made, as follows:

Ten grammes of the finely-powdered drug were macerated with a mixture of 66 volumes of ether, 5 volumes of alcohol, and 2 volumes of alcohol, for 24 hours. The ethereal solution filtered off, and agitated with 15 cc. of water, containing a little sulphuric acid. The ether evaporated off. The residue, tested with Mayer's reagent, gave no reaction.

Fifty grammes were next treated with 3 per cent. of oxalic acid solution at $60^{\circ}\text{C}.$; the filtered solution neutralized with ammonia and evaporated to nearly a syrupy condition. This was shaken briskly with ether, the ethereal solution decanted and allowed to evaporate. The residue, treated with water acidulated with sulphuric acid and tested with Mayer's reagent, as well as other general reagents for alkaloids, gave no reaction for the presence of such a principle.

Distillation of the powdered leaves from potash lye developed a decidedly unpleasant odor, but upon an examination of the distillate no proof was evinced of the presence of a volatile active principle. The above experiments were made only as a preliminary examination of the plant, as a study of its behavior to various processes merely; the writer will take up the subject more completely in the near future. It has been but a few weeks since the plant was sent to the laboratory. A thorough analysis will require several months. A more exhaustive chemical examination is now in process, and will be reported at next meeting.

PHYSIOLOGICAL EXAMINATION.

Through the kindness of Mr. R. E. Steele, referred to above, there was presented an excellent opportunity to personally observe and study the physiological effects of the plant upon animals. A cow had been eating loco for the past year or so, and

had been "crazy"—suffering from the effects of the indulgence for a long time, but, since grass was becoming abundant and loco scarce on the pasturage, she had very recently been improving. This animal was placed at my disposal for examination. Dr. Harding, of Dodge City, was engaged to assist in the contemplated post-mortem, but as he was found too busy at the time, I was thrown upon my own resources. Fortunately, however, I was not without valuable assistance. Mr. A. J. Smith, a recent graduate of the department of pharmacy, who had also taken the preliminary medical course of the University, accompanied me, and we, together with Mr. Steele to do the butchering and heavy work, made the post-mortem. The animal was four years old, but Mr. Steele said no larger than she was at two years. The feeding upon loco had not only stopped her growth, but made her quite poor and gave her a wasted appearance. She seemed stupid and debilitated, unsteady in her movements, the breathing was short and rapid, and muscular force very much impaired. Whether walking or standing, the head was unsteady and trembling. It was seemingly beyond her power to so control the muscles as to keep her head perfectly still. Mr. Steele stated that a sort of wild stare had been in her eyes, but that had recently disappeared.

POST-MORTEM.

The blood was light but not abnormal; having no instrument at hand, it was not microscopically examined. The paunch was in a normal condition; the reticulum and psalterium were softened and apparently diseased. Through the entire length of the intestines there seemed to be a degeneration of tissue, being on the inside peculiarly soft. Two or three perforations were observed in the small intestine. Both the large and small intestines were delicate, devoid of elasticity, and even upon careful handling in some places they would be torn or broken apart. The tissue seemed to be, as one expressed it, rotten in some places. The peritoneum and omentum were inflamed, and throughout were found tumors about the size of a pea, which were fleshy in appearance and of a fibrous nature. The pleura appeared normal, as also did the diaphragm. The pericardium was streaked with red on the inner side, the sac containing about a pint of liquid of a pale yellow color. The heart seemed to be about one-third larger than the normal size. The mitral and tricuspid valves were inflamed around the edges. The valves of the aorta appeared normal, and just above them the serous coat was streaked with red; in other respects appeared normal. The bile was thin and watery, even after standing twenty-four hours. The pancreas and spleen appeared normal; kidneys normal; inner coat of bladder softened. The membranes of the brain were congested and adherent. The congestion may have been caused by the blow on the head previous to killing the animal. She was, however, only stunned by a light blow, and then immediately bled to death. The brain itself appeared paler than normal, but the bleeding may have caused this. The membranes of the spinal cord were inflamed and adherent. The cord itself appeared normal.

Evidently the disease was one of the mucous and serous membranes, which would account for the nervous and debilitated condition of the animal. The general diseased condition of the alimentary canal, by interfering with digestion and proper nutrition, would account for stunted growth and weakness in traveling. This pathological condition would indicate a treatment recommended by Dr. Harding, as follows:

Pulverized extract belladonna.....	10 grs.
Corrosive sublimate.....	1 to 1½ grs.
Licorice.....	1 oz.
Glycerine.....	q. s.

Mix. Make a thin paste, and give a tablespoonful. The belladonna and mercury may be increased according to the severity of the symptoms. Opium combined

with belladonna might be advantageous at the beginning of the disease. Mild and non-irritating articles of food only should be given, such as oil cake, etc. A veterinarian in Garden City recommended the application of a blister behind the ear. This might be good, as also any counter-irritant application along the spine. I am especially indebted for these conclusions and much assistance in making up this report, to Dr. Harding (above referred to), and Dr. Budd Smith, of Grenada, Col.

This examination, while it is very interesting, does not form a basis for any very positive conclusions. It will be necessary, to continue the investigation, to perform a number of like operations. It is very desirable to repeat the experiment of Dr. Harding—all of which the writer is preparing to do as soon as he is able.

ON THE VARIATIONS IN THE SUGAR-CONTENT OF *SORGHUM VULGARE*.

BY J. T. WILLARD.

Individual specimens of all species of plants may be assumed to vary in composition between certain limits. When the variable constituent is a substance of value to man, a determination of the causes of variation and its degree, becomes of importance. Further, we might reasonably hope that, by selecting seed from plants containing the largest percentage of the valuable constituent, the amount might be gradually but permanently increased. This system of seed selection is, of course, commonly practiced, and many of our best varieties of cultivated plants have been produced in this way. But, so far as the writer has been able to ascertain, this system has never been applied to sorghum by saving seed from plants which show by analysis a larger percentage of sugar than the average.

There are some difficulties in the way of improving sorghum by this method. The ordinary farmer cannot apply it, because he has no means of determining the sugar-content of his stalks of cane unless he has a chemist at command. The officials of the Department of Agriculture have never attempted anything of the kind, perhaps because it would require several years of observation before anything definite could be ascertained, and they, like the rest of mankind, desire immediate results, and have little object in inaugurating a series of experiments only to see a successor come in and either take all the credit or drop the work.

The plan of the experiment to be described was this: Kansas Orange sorghum was selected as the variety at present best for this State. By individual analysis of a number of stalks of a size and proportion suitable for perpetuation, I expected to determine if there were any appreciable variations in their sugar-content; then by planting seed from the best stalk, all things considered, I hoped to be able to fix the good qualities of this stalk. It might also be expected that the plants produced by seed from this stalk would exhibit variations in their sugar-content, and that by again planting seed from the best stalk the average might be raised still higher. By continuing in this way a number of years, it seemed possible to so increase the percentage of sugar in sorghum as to make it a much more valuable plant.

The experiment was begun in the spring of 1885, by planting a small amount of Kansas Orange sorghum seed. The soil was in fair condition only. The seed was poor, so that replanting was necessary, making the crop late. The season was, on the whole, rather favorable to the growth of the plant, although it was injured somewhat by drouth. Ten analyses connected with this experiment were made, all after the seed was dry and hard. One of these was of a bent stalk, and the result showed it